

REMARKS

The Examiner's Office Action of June 5, 2002 has been received and its contents carefully noted. Applicant would like to thank the Examiner for the consideration given the above-identified application and for indicating the allowability of claims 3-8 if rewritten in independent form including all of the limitations of the base claim and any intervening claims, which Applicant has done by way of the above amendment. Applicant respectfully submits that this response is timely filed and fully responsive to the Office Action.

Claims 1-8 were pending in this application prior to the aforementioned amendment, with claims 3-8 being indicated as allowable over the prior art of record. By the above actions, claims 1, 2, 3, and 5-8 are amended. In this regard, the following actions have been taken in order to place the subject application in condition for allowance. (1) Claims 1 and 2 have been amended and are believed to be in proper condition for allowance in view of the following remarks; (2) Claims 3, 5 and 6 have been rewritten into independent form including all of the limitations of base claim 1 and intervening claim 2; and (3) Claims 7 and 8 have been rewritten into independent form including all of the limitations of base claim 1. Accordingly, claims 1-8 are pending in this application, and are believed to be in condition for allowance for at least the reasons stated below.

A. Claim Objection

Claim 1 stands rejected as containing an informality. By the above actions, claim 1 is amended so that the limitation "said substrate" recites "a substrate," as suggested by the Examiner. Accordingly, withdrawal of the objection is respectfully requested.

B. 35 U.S.C. §103 Rejection

Claims 1 and 2 stand rejected under 35 U.S.C. §103(a) as unpatentable over (U.S. Patent No. 6,348,096 to Sunakawa et al. (Hereinafter Sunakawa) in view of U.S. Patent No. 6,071,795 to Cheung et al. (Hereinafter Cheung). Please note that claims 1 and 6 are indicated in item 3 of the Office Action (page 2) as subject to the §103 rejection, however, claim 6 is mentioned in item 4 (page 3) as being allowable. Since the Office Action later cites claim 1 and 2 as rejected in view of the aforementioned prior art references, the Applicant intends to address the rejection of claims 1 and 2. Applicant respectfully contends that claims 1 and 2 as presently amended are patentably distinct over the proposed combination of references for at least the follows reasons.

1. Summary of the Invention

The claimed invention in accordance with the pending claims is directed generally to a method of manufacturing a nitride semiconductor substrate comprising: (1) a first step of selectively forming a raised and recessed region in the upper portion of a base substrate; (2) a second step of growing a semiconductor layer of nitride on said raised and recessed region in said base substrate so that a recessed portion in said raised and recessed region is filled and the upper surface thereof is even; and (3) a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer.

Hence, since the base substrate itself includes the raised and recessed region, the semiconductor layer of nitride can be grown on the base substrate without a mask film being provided on the base substrate.

2. The Proposed Sunakawa Combination Fails to Disclose the Claimed Invention

Applicant respectfully contends that the proposed combination of references, namely base reference Sunakawa and secondary reference Cheung, fails to teach, disclose or suggest the claimed subject matter of the pending claims.

For example, as illustrated in Fig. 1(a) Sunakawa discloses a step of growing a Group III-V compound semiconductor film (12) on a substrate (11), thereafter selectively forming a mask (14) on the grown semiconductor film (12), and providing a region where facet structure (16) is not grown. Sunakawa further teaches, in Figs. 1(b)-1(e), a step of selectively growing a Group III-V compound semiconductor layer (15) until a flat surface is produced on top, while retaining the mask (14) on the semiconductor film (12) and using the facet structure (16) as a seed.

Hence, the method in accordance with Sunakawa requires forming a Group III-V compound semiconductor layer on a selectively grown Group III-V compound semiconductor layer and forming a mask composed of a different material on the Group III-V compound semiconductor layer. This is different from the claimed invention since the claimed invention requires that the raised and recessed region be provided on the base substrate on which the semiconductor layer of nitride is grown. In other words, in Sunakawa the mask is required to grow the desired semiconductor thin layer. On the other hand, a mask is not required to grow the desired semiconductor layer in the claimed invention.

The secondary reference Cheung fails to overcome the aforementioned deficiency in Sunakawa since it merely teaches in Figs. 2-6, a method of bonding a thin film (102) composed of GaN and grown on a donor substrate (104), with an acceptor substrate (110) by a bonding layer (108) that is interposed therebetween. Thereafter, the donor substrate (104) is removed from the thin film (102) by irradiating a laser beam (116) from the side of the donor substrate

(104). Hence, since the primary reference Sunakawa fails to teach, disclose or suggest a method requiring forming the raised and recessed region in the semiconductor film itself (substrate), which is selectively grown by the desired semiconductor layer, and the secondary reference Cheung discloses removing the donor substrate from the thin film by laser beam, the claimed invention in accordance with claims 1 and 2 cannot be achieved. Thus, a finding of *prima facie* obviousness cannot be supported. In view of the foregoing remarks, withdrawal of the rejections is respectfully solicited.

Conclusion

In view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that the pending claims be allowed and that the application be passed to issue. If a conference would expedite prosecution of the instant application, the Examiner is hereby invited to telephone the undersigned to arrange such a conference.

Respectfully submitted,



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MARKED-UP VERSION OF AMENDED CLAIMS

1. (Amended) A method of manufacturing a nitride semiconductor substrate, comprising:

a first step of selectively forming [an irregular] a raised and recessed region [on the main surface] in the upper portion of [said] a base substrate;

a second step of growing a semiconductor layer of nitride on said [irregular] raised and recessed region in said upper portion of said base substrate so that a recessed portion in [the irregular] said raised and recessed region is filled and the upper surface thereof is even; and

a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer.

2. (Amended) The method of manufacturing a nitride semiconductor substrate according to claim 1, wherein in said third step, the laser beam is irradiated upon at least a raised portion in said [irregular] raised and recessed region.

3. (Amended) [The method of manufacturing a nitride semiconductor substrate according to claim 2,] A method of manufacturing a nitride semiconductor substrate, comprising:

a first step of selectively forming an irregular region on the main surface of a base substrate;

a second step of growing a semiconductor layer of nitride on said irregular region in said base substrate so that a recessed portion in the irregular region is filled and the upper surface thereof is even; and

a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer,

wherein in said first step, a plurality of grooves extending parallel to each other are formed on said main surface of said base substrate, and

wherein in said third step, the laser beam is irradiated upon at least a raised portion in said irregular region while scanning along raised portions surrounded by said plurality of grooves in said base substrate.

5. (Amended) [The method of manufacturing a nitride semiconductor substrate according to claim 2,] A method of manufacturing a nitride semiconductor substrate, comprising:

a first step of selectively forming an irregular region on the main surface of a base substrate;

a second step of growing a semiconductor layer of nitride on said irregular region in said base substrate so that a recessed portion in the irregular region is filled and the upper surface thereof is even; and

a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer,

wherein in said first step, a plurality of island shaped raised portions are formed on the main surface of said base substrate, and

wherein in said third step, a pulsed laser beam is irradiated upon at least a raised portion in said irregular region while scanning in synchronization with said plurality of raised portions in said base substrate.

6. (Amended) [The method of manufacturing a nitride semiconductor substrate according to claim 2,] A method of manufacturing a nitride semiconductor substrate, comprising:

a first step of selectively forming an irregular region on the main surface of a base substrate;

a second step of growing a semiconductor layer of nitride on said irregular region in said base substrate so that a recessed portion in the irregular region is filled and the upper surface thereof is even; and

a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer.

wherein in said third step, the laser beam is irradiated simultaneously upon the plurality of raised portions in said irregular region.

7. (Amended) [The method of manufacturing a nitride semiconductor substrate according to claim 1,] A method of manufacturing a nitride semiconductor substrate, comprising:

a first step of selectively forming an irregular region on the main surface of a base substrate;

a second step of growing a semiconductor layer of nitride on said irregular region in said base substrate so that a recessed portion in the irregular region is filled and the upper surface thereof is even; and

a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer,

wherein in said first step, the area occupied by the recessed portions is about in the range from about 1/5 to about 100 times the area occupied by the raised portions.

8. (Amended) [The method of manufacturing a nitride semiconductor substrate according to claim 1,] A method of manufacturing a nitride semiconductor substrate, comprising:

a first step of selectively forming an irregular region on the main surface of a base substrate;

a second step of growing a semiconductor layer of nitride on said irregular region in said base substrate so that a recessed portion in the irregular region is filled and the upper surface thereof is even; and

a third step of irradiating an interface between said semiconductor layer and said base substrate with a laser beam, thereby separating said semiconductor layer from said based substrate to form a semiconductor substrate from said semiconductor layer,

wherein in said third step, the laser beam is irradiated from the surface opposite to the main surface of said base substrate.